Climate Change Summary, Fort Matanzas National Monument, Florida

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Climate Trends for the Area within Park Boundaries

- Average annual temperature has increased since 1950, but the rate has not been statistically significant (Table 1, Figure 1).
- Average total precipitation has decreased since 1950, but the rate has not been statistically significant (Table 1, Figure 2).
- Although recent records suggest that climate change may have contributed to an increase in the intensity of North Atlantic hurricanes from 1970 to 2004, the Intergovernmental Panel on Climate Change (IPCC 2013) has concluded that changing historical methods, incomplete understanding of physical mechanisms, and tropical cyclone variability prevent direct attribution of hurricane changes to climate change.
- If the world does not reduce emissions from power plants, cars, and deforestation by 40-70%, models project substantial warming and increases in precipitation (Table 1, Figure 3).
- The greatest projected temperature and precipitation increases are in autumn (Sept.-Nov.)
- Under the highest emissions scenario, models project 20-25 more days per year with a maximum temperature >35ºC (95ºF.) and an increase in 20-year storms (a storm with more precipitation than any other storm in 20 years) to once every 6-10 years (Walsh et al. 2014).
- Projections of North Atlantic hurricanes under climate change do not agree on possible future hurricane trends (IPCC 2013).

Historical Impacts

- Climate change raised global average sea level 19 ± 2 cm (7.5 ± 0.8 inches) from 1901 to 2010 (IPCC 2013) and raised sea level along the Florida coast [See NPS sea level report from Maria Caffrey.]
- Analyses of Audubon Christmas Bird Count data across the United States, including counts in Florida, detected a northward shift of winter ranges of a set of 254 bird species at an average rate of 0.5 ± 0.3 km per year from 1975 to 2004, attributable to human climate change and not other factors (La Sorte and Thompson 2007).

Future Vulnerabilities

- Under the highest emissions scenario, climate change would raise global average sea level 52 to 98 cm (20 to 39 inches) by 2100 AD (IPCC 2013), with sea level increasing along the Florida coast [See NPS sea level report from Maria Caffrey].
- The combination of higher precipitation and increased frequency of large storms could lead to more inland flooding (Ingram et al. 2013).
- Hotter temperatures under climate change will render even more important burrows as thermal refugia for the gopher tortoise (*Gopherus polyphemus*) (Pike and Mitchell 2013).

Table 1. Historical rates of change per century and projected future changes in annual average temperature and annual total precipitation (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation). The table gives the historical rate of change per century calculated from data for the period 1950-2010. Because a rate of change per century is given, the absolute change for the 1950-2013 period will be approximately 60% of that rate. The table gives central values for the park as a whole. Figures 1-3 show the uncertainties.

	1950-2010	2000-2050	2000-2100
Historical			
temperature	+0.1°C/century (0.2°F./century)		
precipitation	-3%/century		
Projected (compared to 1971-2000)			
Low emissions (IPCC RCP 4.5)			
temperature		+1.6°C (+2.9°F.)	+2°C (+3.6°F.)
precipitation		+4%	+6%
High emissions (IPCC RCP 6.0)			
temperature		+1.4°C (+2.5°F.)	+2.4°C (+4.3°F.)
precipitation		+4%	+3%
Highest emissions (IPCC RCP 8.5)			
temperature		+2°C (+3.6°F.)	+3.7°C (+6.7°F.)
precipitation		+4%	+3%

Figure 1. Historical annual average temperature for the area within park boundaries. Note that the U.S. weather station network was more stable for the period starting 1950 than for the period starting 1895. (Data: National Oceanic and Atmospheric Administration, Daly et al. 2008. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

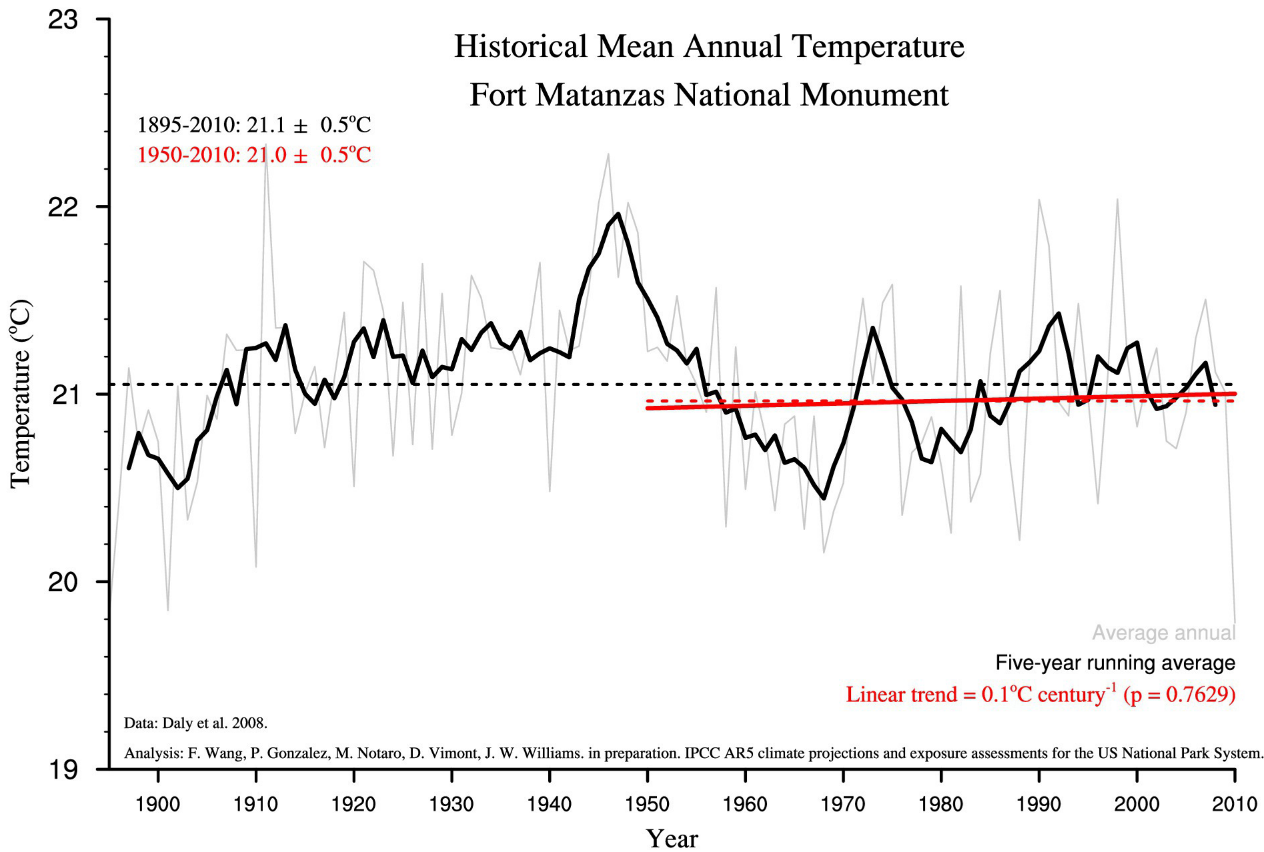


Figure 2. Historical annual total precipitation for the area within park boundaries. Note that the U.S. weather station network was more stable for the period starting 1950 than for the period starting 1895. (Data: National Oceanic and Atmospheric Administration, Daly et al. 2008. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

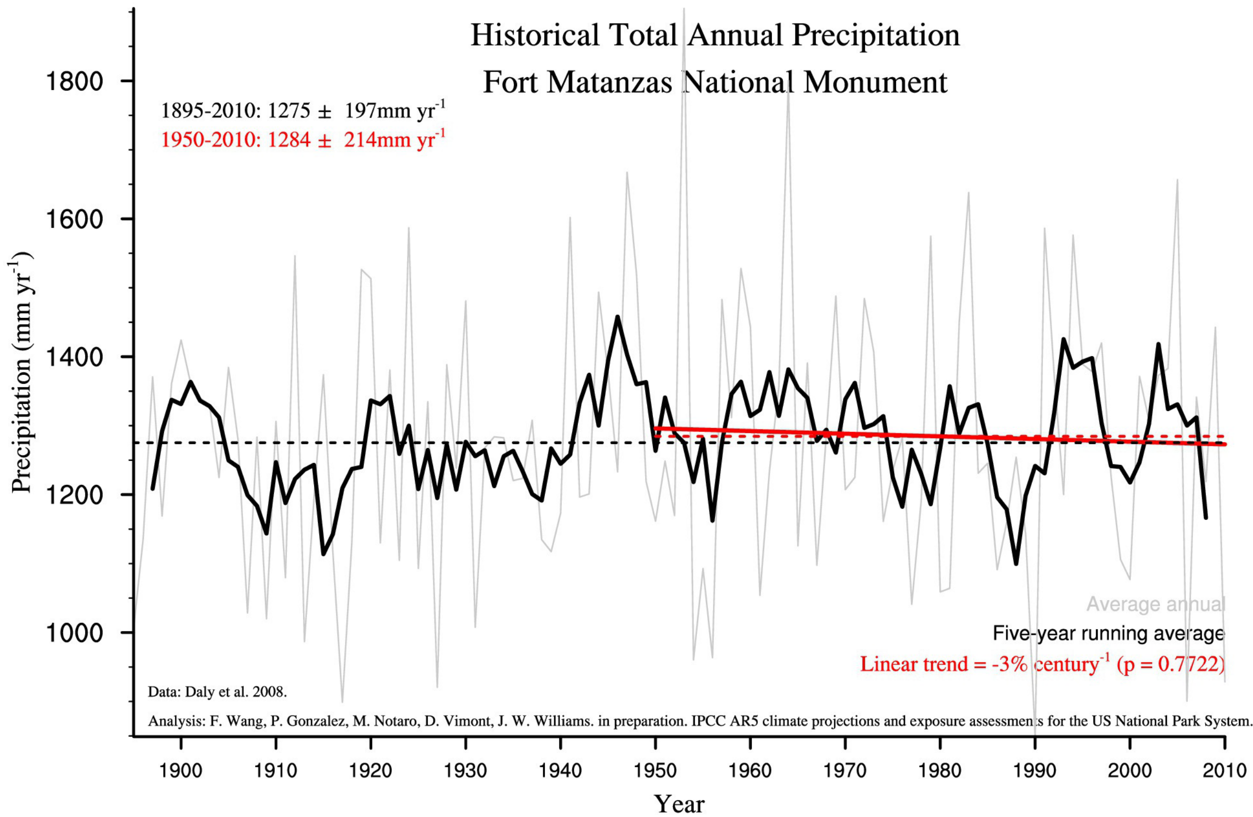
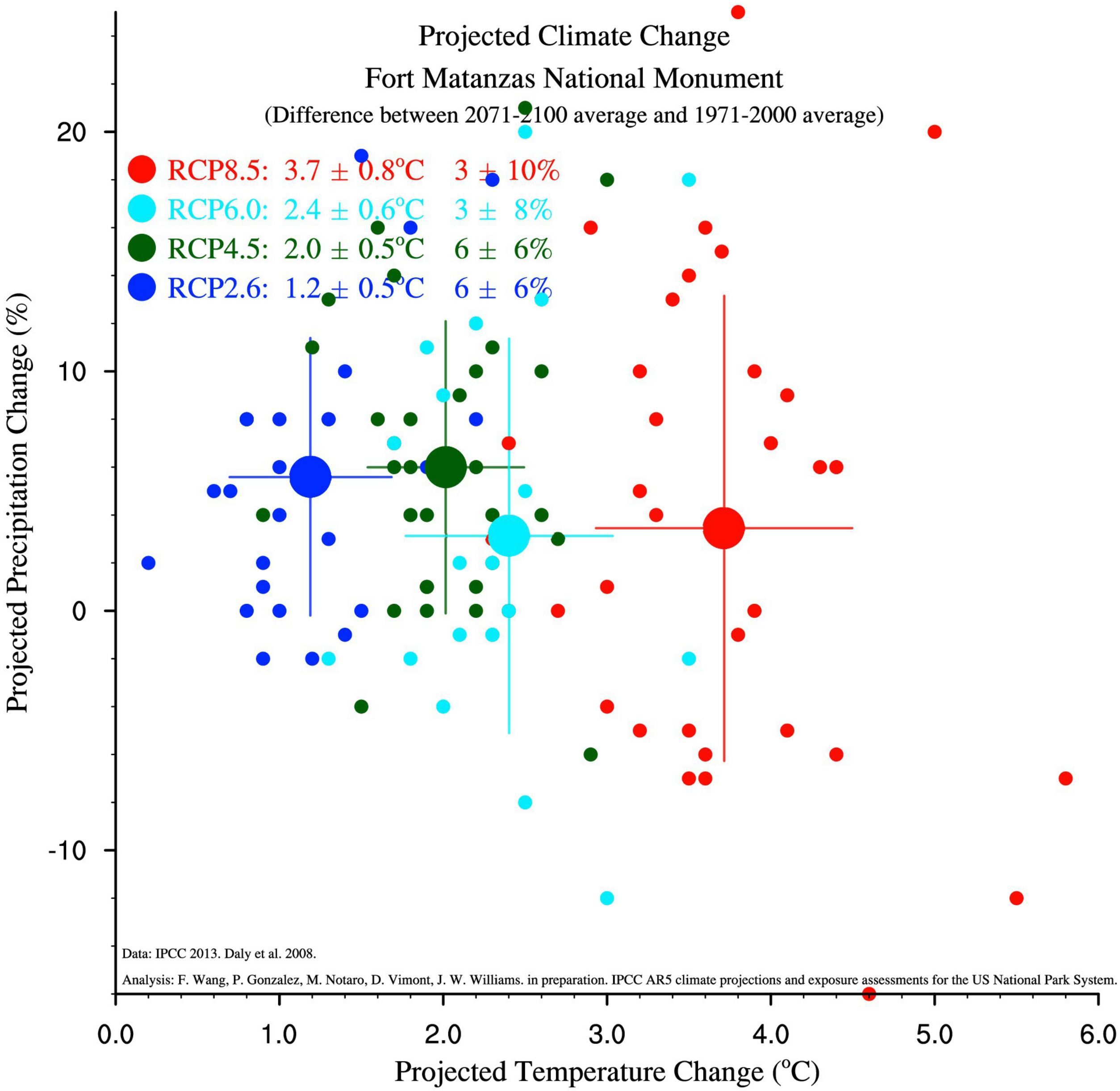


Figure 3. Projections of future climate for the area within park boundaries. Each small dot is the output of a single climate model. The large color dots are the average values for the four IPCC emissions scenarios. The lines are the standard deviations of each average value. (Data: IPCC 2013, Daly et al. 2008; Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).



References

Daly, C., M. Halbleib, J.I. Smith, W.P. Gibson, M.K. Doggett, G.H. Taylor, J. Curtis, and P.P. Pasteris. 2008. Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. International Journal of Climatology 28: 2031-2064.

Ingram, K.T., K. Dow, L. Carter, and J. Anderson. (eds.) 2013. Climate of the Southeast United States: Variability, Change, Impacts, and Vulnerability. Island Press, Washington, DC.

Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013: The Physical Science Basis. Cambridge University Press, Cambridge, UK.

La Sorte, F.A. and F.R. Thompson. 2007. Poleward shifts in winter ranges of North American birds. Ecology 88: 1803-1812.

Pike, D.A. and J.C. Mitchell. 2013. Burrow-dwelling ecosystem engineers provide thermal refugia throughout the landscape. Animal Conservation 16: 694-703

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, and J. Willis. 2014. Our changing climate. In Melillo, J.M., T.C. Richmond, and G. W. Yohe (Eds.) Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, Washington, DC.

Wang, F., P. Gonzalez, M. Notaro, D. Vimont, and J.W. Williams. in preparation. Significant historical and projected climate change in U.S. national parks.